be carried out over a thickness already not exceeding a few nanometers before activation;

- the covering of the transistor with a gate dielectric material, in the form of a layer of material whose thickness is henceforth sometimes less than one nanometer. Thicknesses of this order represent quantities of atoms typically between 10^{13} and 10^{16} atoms per cm^2.

Faced with the production difficulties, semiconductor manufacturers are seeking industrial analytical devices that are capable of reliably characterizing the submicron structures produced. These devices must be sufficiently sensitive and accurate to be able to quantify and monitor, typically with a precision of within 1%, the composition and thickness characteristics of the structures fabricated. These devices must also have a resolution sufficient to allow an analytical check to be made in very small regions that are dedicated for these tests and located on the border of the electronic chips. The size of the test regions is typically of the order of 100 µm × 100 µm. These devices must also establish diagnostics over times compatible with the constraints associated with the production environment. These times are, for example, of the order of a few minutes for inspecting a wafer.

Since the structures produced are becoming finer and finer, to be able to check them requires increasingly precise measurements to be carried out. As regards orders of magnitude of the measurements to be performed, the devices currently available on the market are inappropriate and of insufficient performance. This lack of performance impinges on several aspects, from the lack of precision in the quantitative results to purely and simply the lack of sensitivity.

The object of the invention is in particular to meet the requirements mentioned above. For this purpose, the subject of the invention is a device for measuring the X-ray emission produced by an object exposed to an electron beam. This device mainly comprises:

- electron emission means;
- an acceleration stage in which the electrons are subjected to a potential difference $\Delta V1$;
- a space with no electric field in which the electron beam is shaped and controlled;
- a deceleration phase in which the electrons are subjected to a potential difference $\Delta V2$ of opposite sign to $\Delta V1$;
- a support for positioning the object beneath the electron beam; and
- spectral analysis means for analyzing the X-rays emitted by the object being analyzed.

This device has the advantage of emitting a narrow electron beam, compatible with the abovementioned resolution constraints.

The electron beam exhibits little dispersion, thereby ensuring good illumination precision.

The depth of penetration of the electron beam into the material to be analyzed can be adjusted and advantageously makes it possible to obtain a sensitivity compatible with the constraints associated with the fineness of the layers analyzed.

The intensity of the electron current produced also allows the sensitivity of the device to be increased.

Other features and advantages of the invention will become apparent from the description that follows, given with regard to the appended figures which show:

- figure 1, a schematic representation of the device;

CLAIMS

1. A device for measuring the X-ray emission produced by an object exposed to an electron beam, characterized in that it comprises at least:

- electron emission means;
- an acceleration stage in which the electrons are subjected to a potential difference ΔV1;
- a space with no electric field in which the electron beam is shaped and controlled;
- a deceleration phase in which the electrons are subjected to a potential difference ΔV2 of opposite sign to ΔV1;
- a support for positioning the object beneath the electron beam; and
- spectral analysis means for analyzing the X-rays emitted by the object being analyzed.

2. The device as claimed in claim 1, characterized in that the potential differences ΔV1 and ΔV2 are applied using two generators (14 and 119), the reference potentials of which are connected together, the first generator (14) raising the electron emission source to the potential HV1 and the second generator (119) raising the object to be analyzed (11) to the potential HV2.

3. The device as claimed in claim 2, characterized in that the reference potentials (1111) of the two generators (14 and 119) are connected to the ground of the device.

4. The device as claimed in either of claims 2 and 3, characterized in that the space with no electric field comprises enclosures (16, 111 and 115) that are raised to the reference potential (1111) of the two generators (14 and 119).

5. The device as claimed in any one of the preceding

claims, characterized in that the space with no electric field contains at least means (18 and 116) for shaping the electron beam, having no crossover zone, and to focus it.

6. The device as claimed in any one of the preceding claims, characterized in that it includes an electrode (118) placed between the specimen support and the rest of the device, this electrode being able to be raised to any potential.

7. The device as claimed in claim 6, characterized in that this electrode (118) is a perforated plate, which can be cooled.

8. The device as claimed in any one of the preceding claims, characterized in that the space with no electric field contains means (113) for measuring the intensity of the beam current.

9. The device as claimed in claim 8, characterized in that the means (113) for measuring the intensity of the beam current are associated with electron beam deflection means (112), these deflection means allowing the beam to be directed onto the means for measuring the electron current.

10. The device as claimed in claim 9, characterized in that the deflection means (112) are activated by a rapid electronic system, allowing the measurement to be performed by sampling, during analysis.

11. The device as claimed in any one of the preceding claims, characterized in that the spectral analysis means (1113) comprise at least one WDS spectrometer.

12. The device as claimed in any one of the preceding claims, characterized in that it includes an object chamber (1112) placed in a high, dry vacuum.

13. The device as claimed in claim 12, characterized in that the object chamber (1112) includes a microleak.

14. The device as claimed in any one of the preceding claims, characterized in that it includes optical means for displaying the object analyzed.

15. The device as claimed in claim 13, characterized in that the optical means include at least one catadioptric optic (1114) placed near the object, a pierced deflection mirror (1115) and an external optical system (1116).

16. The device as claimed in any one of the preceding claims, characterized in that it includes an electronic command and acquisition interface (41) connected to the various elements of the device, allowing remote control of the device and acquisition of the data corresponding to the measurements carried out.

17. The device as claimed in the preceding claim, characterized in that it includes a computer (42) connected to the electronic interface (41) and equipped with a man-machine interface for remotely controlling the various elements of the device and for automatically exploiting the measurements made.

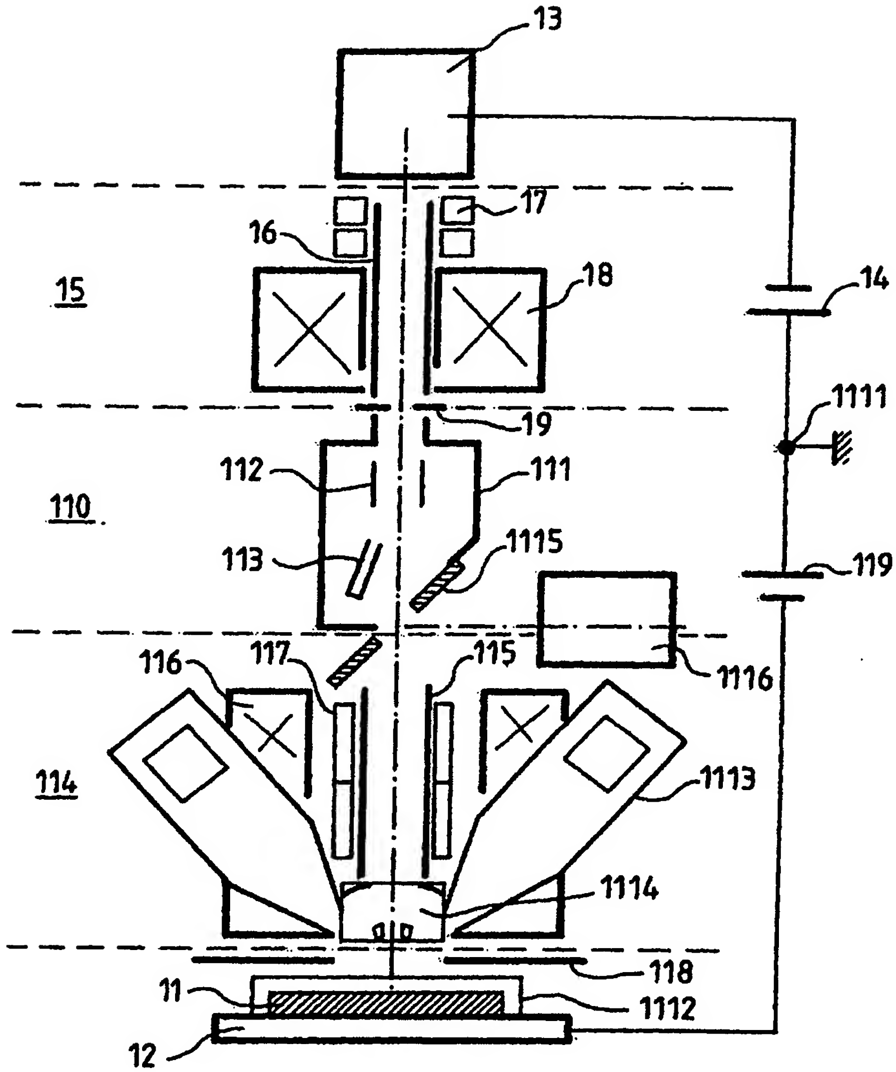
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FIG.1